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AUTHOR Saarni, Carolyn; Thayer, Stephen.
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ABSTRACT

Forty-eight middle-income children, equally divided as to sex, looked at a sequence of animated films in which a pair of male figures underwent a change in facial affect. Three questions were posed: (1) Could a qualitative-structural analysis be applied to the kinds of explanations given by the children to account for changes in facial affect? (2) Is there a relationship between age and the kinds of explanations given? and (3) is there a relationship between a child's level of verbal skill and the nature or social complexity of the explanation offered? The verbal skill measure used was the Peabody Picture Vocabulary Test (PPVT). The results indicated that four basic categories of explanation emerged: (1) mere description, no explanation given; (2) impersonal events or situations cause expression change; (3) third person directly affects the dyad and thus causes facial expression change, and (4) interpersonal relations within the dyad account for expression change. Six- and eight-year olds gave significantly more category 1 responses, and the ten- and twelve-year olds gave significantly more category 4 explanations. Significant age effects were found for the PPVT; however, when the PPVT scores were covaried in a multivariate analysis of variance for age differences in category of explanation offered, significant age differences were still maintained on type of explanation given. Intercorrelations of PPVT and category scores were also undertaken with zero to moderate relationships the result, depending on the age group. No sex differences were found in any of the data. (Author)

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Developmental Changes in Children's
Inferential Explanations of Nonverbal Social Interaction¹

Carolyn Saarni

Stephen Thayer

Dept. of Educational Psychology

Dept of Psychology

New York University

the City University of

933 Shimkin Hall

City College of 139th Street N.Y.

N. Y., N. Y. 10036

N. Y., N. Y. 10031

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The present experiment was designed to find out how children make sense of changes in facial expression shown by a pair of people involved in an interaction; or, in other words, how do children decode nonverbal communication. Three research questions were posed: (a) could a qualitative-structural analysis be applied to the kinds of explanations given to account for changes in expression? (b) is there a relationship between age and the kinds of explanations offered? and (c) is there a relationship between a child's level of verbal skill and the nature or social complexity of the explanation offered?

Four age groups were compared to provide information about developmental trends in the kinds of inferences used by children in reasoning about changes in expressive behavior between others. Earlier research has shown that, based on facial expression alone, children as young as four or five can accurately recognize or identify different emotional states (Deutsch, 1974; Odom & Lemond, 1972; Charlesworth & Kreutzer, 1973). Our intent here was to probe how the child goes beyond perceived facial expressions and corresponding affect and tries to account for its appearance and change. Our expectations as to how children would explain facial expression change in a dyad were derived from Flavell's (1974) discussion of developmental processes in children's inferences about others and from Secord and Peevers (1974) suggestion, based on Heider's work, that early person-attributes would be confused with setting or situation and only "fuzzily" associated with any given individual. In order to make it more difficult for children to use setting

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or situation as cues in accounting for facial expression changes, we created animated films of two figures, walking along and facing each other from a 3/4 perspective, and subsequently changing in facial expression, while the physical setting portrayed in the films was held constant. The primary situational cue, if it can be called that, was that showing two figures next to each other may be suggestive of interpersonal interaction.

The use of animated facial expressions in developmental research on decoding of nonverbal communication is a change from traditional research materials, since most of the research in this area has used static presentation of facial expressions (see Charlesworth's & Krutzer's review, 1973). On the other hand, those studies which have focused on more than just the child's labeling of expressive behavior and which have also used films or video tapes of live interaction have typically not tried to control for extraneous situational cues (e.g., Flapan, 1968; Deutsch, 1974). One possible criticism of the procedure used in the present study might be that we worked with cartoon figures rather than films of real people. However, we saw this as a necessary concession if we wanted to be able to control the nature and amount of stimulus information available to our subjects. Moreover, all of the children in the study were quite familiar with comic books and television or movie cartoons.

Each child's vocabulary level was assessed with the Peabody Picture Vocabulary Test (Dunn, 1965), a reliable and valid test for ages two to eighteen. The test essentially measures vocabulary comprehension rather than vocabulary production. If vocabulary sophistication were highly correlated with more complex inferences about nonverbal communication sequences, then we might conclude that verbal signs and decoding of nonverbal interactions are linked, presumably through some common relationship to symbolic processes. If we found that vocabulary complexity was not related to the inferential reasoning required to decode the meaning of nonverbal communication, then this might suggest that our verbal signs are not particularly relevant to our comprehension of nonverbal signs. A further dilemma here was that

the children were required to use verbal signs to communicate to the experimenter what they inferentially decoded in the nonverbal communication sequences!

Perhaps the larger question raised by this research is whether semiotic skills -- the ability to understand signs and signals -- follow similar developmental pathways in the nonverbal and verbal domains, with the coordination of such developmental pathways perhaps dependent upon the child's cognitive development.

Method

Sample

Forty-eight middle-income children, six-, eight-, ten-, and twelve-years old, equally distributed as to sex and number, served as subjects. Forty-three of the children were white, and five were from minority groups. While the groups were relatively homogeneous in socio-economic status and normal IQ range, strict control over these variables was not crucial in that subject variation was necessary to be able to test for the relationship between inferential decoding of the nonverbal communication sequences and vocabulary complexity.

Procedure

Stimulus films. Animated films were produced in which a pair of schematic male figures, facing one another from a 3/4 perspective, moved along toward an obstacle, which looked like a shed, with a fence in the foreground to add perspective. The two figures disappeared behind the shed and then reappeared but with a combination of facial expressions different from that shown before they went behind the shed. The expressions shown were smiling (S) and frowning (F), with the figures otherwise appearing identical (with the exception of clothing cues so that the children could tell them apart when they reappeared). The two faces, showing the smiling and/or frowning expressions, have been used in another study with adults (static presentation, no animation) and were equated for expression intensity (Thayer, Note 1).

Ten different approach-exit combinations were made, which comprised three different sorts of film sequences. The first film type we called balanced, since

both figures showed the same expressions before and after the change in facial affect. Only two films sequences were made of this type: (a) S_1 and $S_2 \longrightarrow F_1$ and F_2 and (b) F_1 and $F_2 \longrightarrow S_1$ and S_2 . The second type of film was referred to as unbalanced, because the two figures differed from each other, either before or after the change in facial affect. We made five films of this sort: (a) F_1 and $S_2 \longrightarrow F_1$ and F_2 , (b) F_1 and $S_2 \longrightarrow S_1$ and S_2 , (c) F_1 and $F_2 \longrightarrow F_1$ and S_2 , $\longrightarrow$ (d) S_1 and $S_2 \longrightarrow F_1$ and S_2 , and a reversal (e) F_1 and $S_2 \longrightarrow S_1$ and F_2 . The third film type consisted of control film sequences in which no transformation of facial affect occurred. These three films were (a) S_1 and $S_2 \longrightarrow S_1$ and S_2 , (b) F_1 and $F_2 \longrightarrow F_1$ and F_2 , and (c) F_1 and $F_2 \longrightarrow F_1$ and S_2 . Due to fatigue considerations, each child saw only four film sequences, including one balanced combination, two imbalanced combinations, and one control film.

Each film sequence started with a shot of the fence and shed, which lasted for five seconds to allow the child to become familiar with the setting. Next the figures were shown for five seconds before they began to walk, to allow the child to identify clearly the beginning facial expressions. The figures walked toward the shed at a continuous rate of speed, went behind it, reappeared, and continued walking. The time spent behind the shed was equivalent to the time needed to traverse the length of the shed at the same rate of walking as before and after the shed. Finally they came to a stop, where they were then shown for another five seconds to allow the child again to identify clearly the final facial expressions. Excluding the initial shot of the fence and shed, each film sequence lasted about 28 seconds. Each child was interviewed after each film sequence. All interviews were audio-taped and transcribed.

Interview. The children were individually tested. Each child was told: "Now you are going to see a cartoon about two boys who are walking along. One has a white shirt on, the other has a striped shirt. They will go behind a wooden shed. Then they will come out from behind it on the other side. Watch them carefully because I will ask you some questions afterwards about what you saw."

The series of questions asked of each child at the end of each film always began with a request for a "story" about what was seen in the film. If the child identified in his or her story what the facial expressions and/or affects were but did not spontaneously suggest an explanation for why there was a change, probing questions were asked which were of a clinical-dialogue sort (i.e., as used by Selman, 1974; Kohlberg, 1969; and Piaget, 1962). Some children required probing questions to find out if they in fact correctly identified the facial expressions and/or affects.

Qualitative-structural analysis. The task of developing categories by which to code children's "stories" was dealt with by applying Selman's (1974) analysis of social role-taking. His approach is in the Piagetian tradition, whereby the focus is on how the child organizes his/her conceptions of social relations. However, because our subjects were not faced with a problematic dilemma to resolve, as were Selman's, we could not elicit the sheer verbal output nor tap some of the sorts of reasoning revealed by Selman's subjects. Rather than directly apply his stage analysis of children's comprehension of interpersonal relations to our data, we used some of the key ideas that distinguish the less complex stages from the more sophisticated stages of social reasoning as described by Selman (1974).

Category 1 (Stage "0"). From a stage perspective, the child has a sense of differentiation of self and other and can label overt feelings, but does not use causal reasoning in interpreting social action. The thoughts and feelings of self and other are only very vaguely distinguished from one another. In our data a child's story was assigned to category 1 if no explanatory account was given for the nonverbal interaction, despite probing questions; that is, if only a simple description was given by the child. On a very few occasions several children explained the facial expression changes as due to magic, putting on masks, or that different people were involved. These accounts all occurred in the youngest age group and were also assigned a category 1 rating. An example drawn from a transcription is as follows:

Interviewer: "Can you tell me a story about that movie?"

Child: "They both come in and they were, uh, both, uh, mad. Then they passed. One was still mad and one is very happy."

Interviewer: "Why do you think they changed?"

Child: "I don't know."

Interviewer: "Can you make up a story about it?" (long silence)

"When you're mad and then you get to be looking happy, what usually happens to make you go from mad to happy?"

Child: "I just feel better."

Interviewer: "Why?"

Child: "I just do." (Further probes were tried, but with no change in child's responses.)

Category 2 (Stage 1). A child's social reasoning at this second level is characterized by some advance in causal reasoning, and the child distinguishes that the other has a social perspective different from his or her own. However, the child does not consider the mutual or reciprocal influence of interpersonal relations. In our data a child's story was assigned to category 2 if s/he accounted for the affect change in terms of impersonal events, situations, non-social animals, or remote impersonal social transactions (this last item occurred only three times out of 192 film transcriptions), with no mutual interpersonal influence involved. An illustrative part of a transcription is as follows:

Interviewer: "Can you make up a story for that film?"

Child: "They were going to school. And then they sat down. And then they got their report cards. And one of them got a good report card and one of them a bad one."

Category 3 (Stage 2). The child begins to understand that each individual is aware of the other individual's perspective; one's view of the other is now influenced by knowing that the other can be aware of one's own view, however, these reflections occur sequentially rather than simultaneously. In our data a

child's account was assigned to category 3 if s/he explained the changes in facial expression in terms of a third person directly affecting the facial affect of the dyad, with sequential interpersonal influence implied. An example is as follows:

Interviewer: "Try to make up a story about what you saw."

Child: "They were mad. And then one heard a shout. His father screamed at both of them. And his mother did too. And they came and the mother said to tell each other they're sorry. And they came out again and they were happy."

Category 4 (Stage 3). At this fourth level of social reasoning the child can comprehend that both self and other can view one another mutually and simultaneously; the child can step outside of the dyad and reflect objectively on the interpersonal transactions. Children's explanations were assigned to category 4 if they accounted for the nonverbal interactions in terms of direct interpersonal transactions between the figures, including terms indicative of mutual influence and of interpersonal relations. An example is as follows:

Interviewer: "Can you tell me a story about that movie?"

Child: "Well, the first guy could have been the one that was angry the first time. He could have been mad because the other guy was showing off in front of his friends and said he could beat him up and all this. And then he took the other guy behind the wall and beat him up to show him how it felt. And then the other guy got mad that he was beaten up." (This film sequence was F & S ——— S & F or an exact reversal of facial affect on the part of the two figures.)

The transcriptions of the interviews were evaluated by two judges, coding independently. The age of the subjects was not known to the judges. The percentage of agreement was 85%; differences were resolved by conference to yield final assessments.

Seabody Picture Vocabulary Test. This test requires the child to choose from a group of four pictures the one that best defines or is most appropriately implied by a particular word spoken aloud by the examiner. The child does not say anything himself, nor is he required to read anything. S/he can simply point to the correct picture. This test is well suited for testing young children because these features emphasize comprehension rather than production. In the present study the raw scores were used as an index of vocabulary sophistication since the mental age equivalents, available for this test, were not relevant to our research problem. Incidentally, almost all of the children in the present sample obtained raw scores that were at least two mental age years in advance of their chronological age.

Results

Effects of Film Types

A 4 x 4 analysis of variance (four levels of age group by four types of film) was calculated for each scoring category in a split-plot design. The film types were balanced films, in which the two figures showed similar expressions before and after the change; unbalanced films -- each child saw two of these -- in which the two figures differed from one another either before or after the change in facial affect; and control films, in which there was no facial expression change. Neither the main effect of film type nor the interaction was significant.

In order to derive scores for each child, collapsed across film types, frequency scores were assigned to each child based on how many times he gave a response in a particular decoding category for each of the four films, with a maximum frequency score of four for any decoding category. In addition, a weighted summary score was calculated for each child by assigning a weight of one to category 1, a weight of two to category 2, three to category 3, and four to category 4. Weighted summary scores ranged from four (category 1 across all four films) to 16 (category 4 across all four films). These two sets of scores,

frequency and weighted sum, were used in the subsequent analyses.

Sex Differences

While no sex differences were hypothesized, six separate 2×4 analyses of variance (sex by four age groups) were undertaken to test for the main effect of sex on each of the four decoding category frequency scores, for the weighted summary score, and for the Peabody vocabulary test score. No significant sex differences were found, nor was the interaction with age significant in any of these analyses.

Effects of Age

Table 1 presents the frequencies for each age group for the four decoding categories and the means for the weighted summary scores and the Peabody vocabulary test scores for each age group.

 Insert Table 1 about here

The six 2×4 analyses (sex by four age groups) yielded a number of significant findings for the main effect of age. For category 1 (no explanatory account given), a significant age effect occurred, $F(3,40) = 10.11$, $p < .0001$, with planned comparisons indicating that the six- and eight-year old children significantly differed from the ten- and twelve-year old children.

For category 2 (impersonal cause for change in affect), no significant age effects were obtained. For category 3 (third person directly affects the dyad), a significant age effect occurred, $F(2,30) = 3.30$, $p < .05$, however this difference was between the ten-year olds and the two youngest age groups. The twelve-year olds did not differ significantly from the other age groups.

For category 4 (direct dyadic interpersonal interaction causes the change in facial affect), a significant overall age effect was obtained, $F(3,40) = 3.01$, $p < .04$, but planned comparisons did not reveal any specific age group differences.

For the weighted summary score, the age effect was significant, $F(3,40) = 6.06$, $p < .002$, with planned comparisons again showing that the six- and eight-year olds significantly differed from the ten- and twelve-year olds. For the Peabody vocabulary test, a significant age effect was also obtained, $F(3,40) = 61.03$, $p < .0001$, with planned comparisons indicating significant differences between every successive age group.

A one-way multivariate analysis of covariance with the Peabody vocabulary test score as the covariate was calculated to test whether a significant age effect across all the scoring categories would still be obtained. A significant age effect was found, despite vocabulary differences being controlled, with a multivariate $F(12,106) = 1.83$, $p < .05$.

Continuity of Vocabulary Complexity and Decoding of Nonverbal Communication

A correlation between vocabulary score and the weighted summary score was calculated across age groups, yielding a moderate $r = .35$. Age differences were probed by calculating separate correlations according to age group. Significant correlations were obtained for the eight- and ten-year olds ($r = .62$ and $r = .59$, $p < .05$, respectively), but the six- and twelve-year olds clearly did not obtain significant correlations between their vocabulary scores and weighted summary scores ($r = .16$ and $r = .01$, respectively). It would appear that a moderate degree of relationship exists between vocabulary sophistication and decoding of nonverbal transformations for the middle-range children in this sample, while for the youngest and oldest children this positive relationship does not hold.

Discussion

The study described here was an attempt to provide basic developmental information about children's understanding of changes in facial expression in the context of inferred social interaction. A qualitative-structural analysis for children's explanations was developed, which derived its conceptual rationale from Selman's (1974) stages of social-role-taking. This system of analysis yielded four decoding categories which were applied to the children's inferential accounts.

Use of these categories indicated that a major shift occurs in middle childhood, at which time the inferential decoding process changes from a simple descriptive/non-explanatory basis to a causality-oriented, interpersonal interaction basis for decoding nonverbal communication. Illustrative of this shift is the fact that not one twelve-year old received a category 1 rating, and 80% of the twelve-year olds' responses fell in category 4. However, our middle categories (2 and 3) did not clearly distinguish among the age groups.

Another research goal was to examine the role that vocabulary sophistication might have on the complexity of children's inferences about the meaning of non-verbal communication. The results suggest that vocabulary sophistication was differentially related to complexity of children's inferences, depending on the age group. The six-year olds' zero correlation between vocabulary sophistication and complexity of inferential decoding of nonverbal transformations may have reflected their relative inability to map verbal and nonverbal symbolic processes onto each other in a fluid fashion. Thus their decoding of nonverbal signs remained discrete from their decoding of verbal signs. The eight- and ten-year olds' moderately positive correlations between vocabulary sophistication and complexity of inferential decoding indicates that as their sophistication in decoding verbal signs increased, so did their complexity in decoding nonverbal signs. In middle childhood, then, systems for reciprocal transformations in the verbal and nonverbal domains appear and may mutually facilitate the decoding accuracy and sophistication in both domains.

The twelve-year olds' zero correlation between vocabulary level and decoding of the nonverbal transformations may also be understood within the proposed framework of gradually-constructed rules for mapping different sign systems onto each other. The twelve-year olds may have reached a sophistication level in their inferential decoding of nonverbal signs (on this particular task) that was readily and reciprocally mapped onto verbal signs. Individual differences in vocabulary sophistication in this age group were either not tapped in the decoding required

for the particular nonverbal task used here, or possibly represented further refinement within the domain of decoding verbal signs beyond the level required for adequately "translating" nonverbal signs into verbal signs and vice-versa.

In conclusion, a number of investigators have shown that older children, who are presumably cognitively more complex, are more likely to go beyond the information given, to explain rather than merely describe the occurrence of events. Certainly this research picked up on this trend. What we wish to emphasize further is that not only did our oldest subjects feel pressed to explain why facial expressions might change, but they were also saying that people are not angry or happy in a social vacuum; people feel as they do because of their relations with other people. Although younger children may well have the cognitive competence to comprehend affect change as dependent on interpersonal relationships, they do not appear capable of producing or articulating a sociocentric perspective in our animation task of changing facial expressions.

Footnotes

1. The authors are grateful to Anita Bohensky and Paul Ramirez for assistance with data collection.

Notes

1. Thayer, S. The role of facial expression, expression intensity, and interpersonal distance on observer inference of relationship quality. Unpublished manuscript, City College of the City University of New York, December, 1975.

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Table 1

Frequency of Categories, Mean Weighted Summary Score, and
Mean Peabody Picture Vocabulary Test for All Age Groups

Age Group	Category 1 (no explanation)	Category 2 (impersonal explanation)	Category 3 (third person explanation)	Category 4 (interpersonal explanation)	Weighted Summary Score	Peabody Picture Vocab. Test
6-year olds	20	5	2	21	10.00	66.83
8-year olds	11	8	2	27	11.75	78.08
10-year olds	3	4	8	33	13.92	92.17
12-year olds	0	7	3	38	14.58	110.67